Journal of the Society of Arts.

FRIDAY, JUNE 17, 1859.

EIGHTH ANNUAL CONFERENCE.

The Institutions in Union are requested to take notice that the Eighth Annual Conference between the Representatives of the Institutions in Union and the Council, will be held on TUESDAY, the 28th inst. at 10 o'clock in the morning. C. Wentworth Dilke, Esq., Chairman of the Council, will preside. Institutions are requested to forward, as soon as possible, to the Secretary of the Society of Arts, the name of the representative appointed to attend the Conference.

The Chairmen of, or Representatives from, the several Local Boards of Examiners, are invited to attend the Conference.

The following letter has been addressed to the Institutions and Local Boards :—

Society of Arts, Manufactures, and Commerce,
11th June, 1859.

Sir,—I am directed by the Council to inform you that the Eighth Annual Conference with the Representatives of the Institutions in Union will be held here on Tuesday, June the 28th, at 10 o'clock precisely. Mr. C. Wentworth Dilke, the Chairman of the Council, will preside.

The Council hopes that your Institution (or Local Board of Examiners) will not fail to appoint a representative to attend the Conference; and that you will communicate to me, at your earliest convenience, the name of the Representative appointed. The Council will lay before the Conference a report of the proceedings of the Union during the year now about to end, and a programme of the Examinations for 1860. Among the questions which the Council will propose to the Conference for consideration are the following :—

1. What arrangements can be made to enable the smaller and poorer Institutes to profit by the Examinations without loss to the Society of Arts?
2. Is it expedient to further define and prescribe the constitution and modes of action of the Local Boards?
3. Is it expedient to continue the system of giving prizes in addition to the certificate?
4. Would the Institutions, at their own cost, wish to receive, according to a rota, for local Exhibition, collections of some of the more portable and useful of the articles that are annually exhibited by the Society of Arts?
5. Can the Museums and Galleries in the metropolis, which are the property of the public, or subsidised from the public funds, be rendered useful to the Institutions in different parts of the country, by systematically lending to them specimens for Exhibition, or by granting to them unrequired duplicates?
6. Should an effort be made by the Union to procure the opening of the National Museums and Galleries to the public of an evening?
7. Is it expedient to apply to Parliament to extend to the Institutes and to the Local Boards the operation of the Free Libraries' and Museums' Acts?
8. Is it expedient that the Society of Arts should annually visit some one of the large manufacturing towns where there are Institutes in union with the Society; and, if so, under what circumstances and conditions should such visits be made?
9. Do the Institutions agree with the Council in thinking it desirable to provide at the house of the Society facilities for the admission of members of the Institutions, visitors in London, to the different establishments and objects of public interest accessible gratuitously by ticket, and for seeing which much curiosity is usually felt by strangers?

With reference to the questions numbered 1, 2, 3, and 7, I am to explain that, as the system of previous Examinations by Local Boards, and of Final Examinations by the Society of Arts Central Board has now been tried for two years with great and increasing success, the Council wishes to have it considered whether that system may not now be more perfectly organised.

You will see that these subjects are of no little importance, and the Council of the Society of Arts hopes that you will send a representative prepared to discuss them.

The Council has reason to believe that it may be proposed to the Conference to consider whether it is expedient for the Institutions to ask the Committee of Council on Education to give the Evening Classes of Institutions the Grants which that Committee gives to the Evening Classes which are connected with inspected day-schools.

If there be any other subject which your representative may wish to submit to the conference, it would be convenient that you should give me notice of it.

I shall be obliged by your sending me, by return of post, a copy of your last annual report.

The chair of the Conference will be taken, and the business will begin, PUNCTUALLY at 10 o'clock. At half-past one the Conference will be adjourned for twenty minutes.

The One Hundred and Fifth Anniversary Dinner of the Society will take place at St. James' Hall, Piccadilly, on the same day (Tuesday, the 28th of June), at half-past six for seven o'clock precisely. The Right Honourable Lord Napier will preside. Applications for tickets (price 10s. 6d. each) should be made to Mr. Samuel Thomas Davenport, at the Society's House, Adelphi, London, W.C. The tickets will be ready for delivery on and after the 13th instant.

I am, Sir,
Your obedient Servant,
P. LE NEVE FOSTER, Secretary.

ANNUAL DINNER.

The One hundred and fifth Anniversary Dinner of the Society will take place at St. James's Hall, Piccadilly, on TUESDAY, the 28th inst., at half-past six for seven o'clock precisely. Members and their friends are requested to take notice that tickets (price 10s. 6d. each) may be had at the Society's House, on and after Monday, the 13th instant. The Right Hon. Lord Napier will preside.

ANNUAL GENERAL MEETING.

The one hundred and fifth Annual General Meeting, for the purpose of receiving the Council's Report, and the Treasurers' Statement of the Receipts, Payments, and Expenditure during the past year, and also for the Election of Officers, will be held on Wednesday, the 29th inst., at four o'clock, p.m.

EXAMINATIONS, 1859.

The following Prizes have been awarded to Institutions and Local Boards, in accordance with the conditions* set forth at page 9 of the Examination Programme for this year :—

PRIZES TO INSTITUTIONS.

One Prize of £5 to the Mechanics' Institution, Glasgow, in respect of Candidate No. 51, John Palethorp, who obtained the First Prize in Arithmetic.

One Prize of £5 to the Royal Polytechnic Institution Classes, in respect of Candidate No. 471, Frederick William Rudler, who obtained the First Prize in Electricity, Magnetism, and Heat.

One Prize of £5 to the Birmingham and Midland Institute, in respect of Candidate No. 375, Charles Josiah Woodward, who obtained the First Prize in Chemistry.

One Prize of £5 to the People's College, Sheffield, in respect of Candidate No. 123, William Martin Wood, who obtained the First Prize in Political Economy.

One Prize of £5 to the Mechanics' Institution, Halifax, in respect of Candidate No. 487, William Thomas Dewhirst, who obtained the First Prize in Geography.

One Prize of £5 to the Mechanics' Institution, Glasgow, in respect of Candidate No. 32, William Cree Crawford, who obtained the First Prize in French.

One Prize of £5 to the Crosby Hall Evening Classes, in respect of Candidate No. 514, Samuel Lee Cressall, who obtained the First Prize in German.

No Prizes are awarded to Institutions in respect of the Candidates who obtained First Prizes in Book-keeping, Algebra, Geometry and Mensuration, Trigonometry, Conic Sections, Statics, &c., English History, English Literature, and Latin and Roman History, it having been ascertained that these Candidates had not received "systematic instruction" in these subjects at their respective Institutions "for a period of not less than three months," as required by the conditions.

PRIZES TO LOCAL BOARDS.

The Prize of £10 to the Local Board at the Leeds Young Men's Christian Institute.

The Prize of £8 to the Local Board at Bristol.

The Prize of £6 to the Local Board at the Glasgow Mechanics' Institution.

The Prize of £4 to the Local Board at the Halifax Mechanics' Institution.

The following errors have been pointed out in the list of successful candidates published in last week's *Journal*:—

At page 513, line 24 (No. 408, Charles Payne Evanson), for "Mensuration (2nd)" read "Music (2nd)." At page 511, line 11 from bottom, for "Anty" read "Auty." At page 513, last line but one, for "Hawes" read "Haves."

* The conditions are as follows:—

"The following Prizes are offered to the Institutions, viz.:—To the Institution whose Candidate obtains the First Prize of £5 in each of the 23 Sub-Divisions of Subjects, one Prize of £5. An Institution can take more than one such Prize: but no such Prize can be taken by an Institution unless the Council of this Society are satisfied that the Candidate, in respect of whom the Prize is claimed, has received at the Institution systematic instruction in the subject for a period of not less than three months.

"The following Prizes are offered to the Local Boards, viz.:—To the Local Board whose Candidates obtaining Certificates of the first class (not fewer than ten) bear the largest proportion to its whole number of Candidates: One Prize of £10.—To the Local Board whose Candidates obtaining Certificates of the first class (not fewer than eight) bear the largest proportion to its whole number of Candidates: One Prize of £8.—To the Local Board whose Candidates obtaining Certificates of the first class (not fewer than six) bear the largest proportion to its whole number of Candidates: One Prize of £6.—To the Local Board whose Candidates obtaining Certificates of the first class (not fewer than four) bear the largest proportion to its whole number of Candidates: One Prize of £4.—No Local Board can receive more than one of these Prizes. These sums may be applied by the Local Boards to the payment of the expenses of the Examination, or otherwise, as the Board may deem best for the promotion of the objects for which it was instituted."

UNIFORM MUSICAL PITCH.

The Council, in accordance with the powers given to them by the resolution passed at the meeting in reference to this subject, held at the Society's house on Friday, the 3rd instant, have added the following gentlemen to the Committee then appointed :—

Mr. HOBBS.
Mr. G. A. MACFARREN.

OPENING OF GALLERIES OF ART IN THE EVENING.

The following is a report of what took place in the House of Lords, on Friday evening last, the 10th inst., in reference to this subject :—

The Earl of SHAFTESBURY moved for a copy of the correspondence between the Trustees of the National Gallery and the Council of the Society for the Encouragement of Arts, Manufactures, and Commerce with reference to the opening of the Vernon and Turner galleries of pictures at South Kensington of an evening; and also for copies of all letters and memorials on the same subject which may have been received by the said trustees up to the date of their making the returns now moved for.

The Marquis of SALISBURY said he should offer no objection to the production of the correspondence.

After a few words from Lord MONTEAGLE,

Lord OVERSTONE said the trustees of the National Gallery sought to promote no other end than that the treasures in their custody should as far as possible be open to the public, and made to contribute to their rational amusement as well as their intellectual improvement. The question of opening picture galleries in the evening was, however, entirely a new one, and before such a step was taken, the effect of gaslight upon the paintings ought to be carefully considered. No national collection of pictures in the world had, he believed, up to the present time been thrown open in the evening; but whether that might be done without any injurious result was, no doubt, a point deserving of attention. He had only to add that he had attended a meeting of the Trustees of the National Gallery on Monday last, when Sir C. Eastlake had undertaken to investigate the question with a view to its solution.

Lord ST. LEONARD's was of opinion that great danger would result from lighting up the National Gallery or any other of our great picture galleries at night. He could not, also, help remarking that they would, if opened in the evening, be likely to be visited for the purpose of conversation rather than with a view to the inspection of the paintings.

The Earl of DERBY said there could be no sort of objection to the papers asked for by his noble friends, but the present was hardly the time for the discussion of the question whether the gallery should be open or not. (Hear, hear.)

Lord STANLEY of ALDERLEY did not wish to pronounce an opinion on the propriety of lighting up the gallery with gas, but would remind the House that the Sheepshanks Collection was now exhibited at night, and that a valuable boon was thus granted to persons who had not time to inspect these pictures during the day. He would suggest to the Government whether some plan might not be adopted by which the light should be admitted at the top, as in the House of Commons, so that

the fumes of the gas could not injure the pictures. (Hear, hear.)

The motion was then agreed to.

The following letter has been addressed to the Trustees of the National Gallery, by the Earl of Shaftesbury, as President of the Young Men's Christian Association :—

Young Men's Christian Association, 165, Aldersgate-street, London, E.C., 26th May, 1859.

SIR,—With reference to the letter addressed by the Council of the Society of Arts to the Trustees of the National Gallery, urging upon them the importance of allowing the several collections of Paintings, which are National property, to be opened to the public during suitable hours in the evening, for the convenience and instruction of the large class of persons whose avocations render it impossible for them to take advantage of the opening of the public Galleries and Museums during the day, I beg, as President of the Young Men's Christian Association, very earnestly to support this appeal for an act of consideration to the multitude of clerks, shopmen, traders, artizans, and others engaged in the active business of life, which will be deeply and gratefully appreciated by them, and which will, apart from its educational value and importance, tend to produce the most valuable moral results.

The experience acquired in the various labours of this Association justifies the assertion, that a large proportion of the follies and vices of young men arise not so much from a mere propensity to indolence and irregularity of conduct, as from the very general privation of social and domestic comforts, and the absence of opportunities for safe and suitable recreations and enjoyments.

To secure to them, therefore, the advantage of free access, in their leisure hours, to our National Museums and Galleries, will be to provide a most salutary check to the influence of evil habits, and, in improving the moral tone and character of this large class of the community, to elevate the manners and increase the comforts of society at large.

Its bearing upon those aspects of sanitary reform which are associated with the character and condition of the dwellings of the people, is scarcely less important; and upon all these grounds I most earnestly commend the desired alteration to the most favourable consideration of the Trustees of the National Gallery.

I am, Sir,
Your obedient servant,
(Signed) SHAFTESBURY.

The Secretary to the
Trustees of the National Gallery.

SPANISH EXHIBITION.

An Exhibition of Industry is appointed to be held in Madrid in 1862. It will be confined to the products of Spain, Portugal, and the American Republics of Spanish origin.

MANUFACTURES, PROPERTIES, AND APPLICATION OF WATER GLASS, INCLUDING A PROCESS OF STEREOCHROMIC PAINTING.

BY DR. JOHANN NEP. FUCHS.

(*Translated by desire of and communicated by H.R.H. the Prince Consort, President of the Society of Arts.*)

In 1825 I had an opportunity of publishing a paper on water-glass, which at that time, however, did not meet with the attention which the subject well deserved. It was even stated that it differed in no respect from the well-known "liquor silicum," and consequently was nothing new. A few voices only were raised in its favour, auguring well for its future. Some experiments on its intended application were made, but abandoned as soon as they did not lead to satisfactory results, undertaken as they were without the necessary knowledge or understanding. Great were the expectations raised by the discovery, greater often than in the nature of things could be realized. Failures, owing perhaps to faulty manipulation, frequently caused it to be abandoned before it had been put to a fair test. There are always persons to be found, who, themselves unable to carry on experiments, are always ready to condemn those of others upon the faith of a single experiment in which they failed, as I have experienced myself more than once.

An inert love of the customary and habitual, almost invariably exerted the usual adverse influence; for it seems to to be the fate of anything new to be looked upon with aversion for some time before it is appreciated.

A few years have changed much, and it has been thought since that the water-glass, after all, did not belong to the class of superfluous things, and that few other bodies were capable of being put to so many various applications. I have naturally taken considerable interest, and have had a share in several applications and experiments made with a view of advancing this affair, and was therefore induced to write this pamphlet while life is still spared me, in order to render the experience gained by myself and others available for further investigations.

The manufacture and the properties of the water-glass have been described at some length in Kastner's Archiv*. I have, however, thought it desirable to reproduce the more essential parts of that paper, since I am able to introduce many improvements, and to treat more amply of things which at that time met only with a short indication.

SECTION I.

VARIOUS KINDS OF WATER-GLASS, AND THEIR MANUFACTURE.

We have to distinguish four kinds of water-glass :— a. Potash water-glass. b. Soda water-glass. c. Double water-glass. d. Fixing water-glass.†

At first, and for some time afterwards, my attention was merely directed to potash water-glass,‡ and as nearly all the experiments which I shall have to mention were made with it, I may as well state that potash water-glass is meant whenever the expression water-glass is employed.

MANUFACTURE OF POTASH WATER-GLASS.

A mixture of 15 parts of pulverized quartz, or pure quartz sand,
,, ,, 10 parts of well-purified potash,
,, ,, 1 ,, powdered charcoal, may be conveniently employed.

* See Kastner's Archiv for Natural Philosophy of 1825, vol. v. p. 385—412. Separately printed by Leonhard Schrag, of Nüremberg, with the title: On a new product from Silica and Potash, by Dr. Johann Nep. Fuchs, Professor of Mineralogy.

† The name "water-glass" is, in fact, a generic name employed when speaking of the above four varieties. I do not know whether a lithia water-glass might be obtained. Perhaps a good double water-glass of potash and lithia might be produced by replacing a part of the potash by lithia, for which purpose lepidolite could be conveniently employed. This double water-glass would no doubt be rather expensive; cases might, however, occur where expense would be a matter of secondary importance.

‡ M. F. Fikentscher, chemical manufacturer of Zwickau, in Saxony, was the first to manufacture water-glass on a somewhat larger scale, and of the best quality. He would no doubt manufacture soda water-glass also, if required, of an equally good quality and at a cheap rate.

These ingredients are to be well mixed and exposed to a st ong heat in a fire-proof melting-pot for five or six hours, until the whole fuses uniformly and steadily: as much heat is required as is necessary to melt common glass. The melted mass is then taken out by means of an iron spoon, and the melting-pot immediately refilled with a fresh quantity. It is then broken up, pulverized, and dissolved in al out 5 parts of boiling water, by introducing it in small portions into an iron vessel and constantly stirring the liquid, replacing the water as it evaporates, by adding hot water from time to time, and continuing to boil for three or four hours, until the whole is dissolved,—a slimy deposit excepted,—and until a pellicle begins to form on the surface of the liquid, which indicates that the solution is in a state of great concentration; it disappears, however, when the liquid is stirred; and the boiling may then be continued for a short time, in order to obtain the solution in the proper state of concentration, when it has a specific gravity of from 1·24 to 1·25. In this state it is sufficiently liquid to be used in many operations; in some instances it will be necessary to dilute it with more or less water. When evaporated to a syrupy consistence, it can be employed with advantage in but few cases.

Very frequently it is found contaminated with a little sulphide of potassium, and it becomes necessary to add a little oxide of copper or copper scales towards the end of the boiling, which liberates a small quantity of potash, but which renders it rather more suitable for many practical purposes than otherwise. If it is desirable, however, to have a water-glass which is entirely neutral, it requires to be boiled with freshly-precipitated silica as long as any silica is dissolved.

Freshly precipitated or gelatinous silica offers, in fact, the best and most convenient means of ascertaining whether a sample of water-glass is completely saturated with silica, by introducing it in small portions into the boiling liquid, when a saturated solution will dissolve no more, whilst an incompletely saturated solution takes up more or less.

Litharge may also be employed instead of oxide of copper, in order to remove the sulphide of potassium, but requires to be added with great care, since an excess causes the water-glass to coagulate.

The solution is allowed to cool, and left to clear in the well-closed iron vessel. The clear liquid is then decanted off from the deposit (which may serve as a good manure) and filled into stoppered bottles or carboys, and kept for use under the name of potash water-glass.

It may also, for better transport, be evaporated to a gelatinous mass by constantly stirring the liquid, and then packed into tinned iron vessels.

Alcohol furnishes even a more ready means of preparing it in a solid state. By adding one-fourth volume of rectified spirits of wine to a concentrated solution, a gelatinous precipitate is produced, which strongly contracts after a few days, and is deposited on the bottom of the vessel in a solid mass. If the supernatant liquid, which very frequently contains a little carbonate of potash, traces of chloride of potassium, chloride of sodium, and sulphide of potassium, be decanted, and the deposit slightly washed with cold water and squeezed, the water-glass is obtained in a solid and very pure state, and completely saturated with silica. Water dissolves it easily and completely.

Manufacture of Soda Water-glass.

Soda water-glass is prepared in the same way as potash water-glass; but since soda is capable of saturating more silica than carbonate of potash, it is evident that an equal quantity of quartz requires less carbonate of soda.

A mixture of—

45 lbs. of quartz,
23 ,, ,, anhydrous carbonate of soda,
3 ,, ,, charcoal dust.

may be employed for a large charge.

The mixture fuses somewhat easier than potash water-glass. Professor Buchner has found that it can be prepared cheaper by means of Glauber's salt or sulphate of soda, in the proportion of—

100 parts of quartz,
60 ,, ,, anhydrous sulphate of soda
15-20 ,, ,, charcoal dust.

When the mass is completely saturated with silica, it gives with water a somewhat more opaque liquid than the glass prepared from potash in a like state of concentration.

Rectified alcohol does not precipitate it completely like potash water-glass, merely converting it into a gelatinous mass, and giving no precipitate at all, or only after a short time, when it is not completely saturated with silica, or when slightly diluted. This deportment enables us easily to distinguish it from potash water-glass.

Manufacture of Double Water-glass.

Potash and soda water-glass are miscible in all proportions. A mixture of equal equivalents of potash or soda, however, must be considered to furnish the normal double water-glass, which is invariably obtained when 100 parts of quartz and 121 of seignette salt are fused together. This method being too expensive for all practical purposes, may be modified by employing equal equivalents of nitrate of potash, nitrate of soda, and the corresponding amount of quartz, which furnish a cheap glass suitable for all technical applications. It may also be prepared by fusing together quartz, carbonate of potash, and carbonate of soda in the following proportions:—

100 parts of quartz.
28 ,, ,, purified potash.
22 ,, ,, neutral anhydrous carbonate of soda.
6 ,, ,, powdered charcoal.

This mixture is much easier to fuse than any of the previous ones.

A mixture of three measures of concentrated potash water-glass with two measures of concentrated soda water-glass, producing a soluble double water-glass, will be found to answer for all practical applications.

Fixing Water-glass and its Manufacture.

I was for a long time of opinion that the ordinary water-glass, after being completely saturated with silica, forms the best and the most suitable for all purposes. A serious inconvenience, however, showed itself in its application to stereochromy: in the last operation, that of fixing the colours, the pictures assumed a cloudy and dirty appearance in consequence of the rapid partial decomposition of the water-glass. This drawback caused Herr von Kaulbach and myself much anxiety, and suggested the idea that in this case the water-glass ought not to be completely saturated with silica. A few experiments proved this opinion to be correct; and by adding a portion of soda liquor silicum, or soluble silicate of soda, to the ordinary water-glass completely saturated with silica, I obtained a water-glass which perfectly answered the purpose. I shall call this mixture *fixing water-glass.*

In order to prepare the soluble silicate of soda (liquor silicum), three parts of pure anhydrous carbonate of soda are fused together with two parts of powdered quartz. It is kept in a rather concentrated solution, and one part by measure added to four or five parts of the concentrated potash water-glass completely saturated with silica. By this means silica and an excess of alkali are added, which are sufficient to prevent its rapid decomposition, without preceptibly altering its other properties. The water-glass, which was dull or opaque, is thereby rendered perfectly clear and a little more soluble. There is no reason why its use should be restricted to stereochromy, and why it should not be employed for various other purposes with great advantage.

Properties of Water-glass, and its Deportment with other Bodies.

It is important to study thoroughly its action upon other bodies in order to prevent errors, or drawing erroneous conclusions from certain changes or phenomena.

Solid or fused water-glass, if pure, has the appearance of ordinary glass, and dissolves gradually but completely in boiling water; in the cold, however, the solution proceeds so slowly, that one feels inclined to believe that it is entirely insoluble in cold water. It becomes entirely insoluble only when a much larger quantity of silica has been added and made to combine with it, or when a portion of potash has been withdrawn; frequently, also, when other bodies, viz., earths or oxides of the metals, &c., have been mixed with it, which form double or triple silicates, such as many mineral compounds and common glass itself is composed of; for I have always noticed that silica combines more readily with two bases than with one.

Acids—carbonic acid not even excepted—decompose the solution and separate silica in a gelatinous form. Solid water glass is readily acted upon by dilute acids, and silica is separated in the form of a powder.

Salts of the alkalies, especially the alkaline carbonates or chlorides, cause viscous precipitates from a concentrated solution, and the whole solution seems to coagulate. In dilute solutions, a precipitate appears only after some time. Sal-ammoniac acts most powerfully by producing, even in a very dilute solution of the water-glass, a flaky precipitate, ammonia being simultaneously evolved. On washing this precipitate with water acidulated with nitric acid, pure silica is left on the filter.

The alkaline earths set free more or less potash on being brought into contact with a solution of water-glass, and combine with the rest of the potash to form double salts which are quite insoluble in water.

Alumina combines likewise with it, and forms a product insoluble in water; it is therefore necessary that the quartz which is used in the manufacture of water-glass should not contain any alumina. The insoluble residue which is left behind when the fused mass is dissolved in water, is probably owing to the alumina which the glass has taken up from the glass-pot.

If the water-glass is dissolved and exposed to the air in open vessels, it attracts carbonic acid and suffers decomposition, which causes it to coagulate sooner or later, and produces gradually a slimy deposit, which was found by Professor Buchner to contain potash.

Heat accelerates this decomposition. If the liquid is evaporated and the dry mass made anhydrous by further heating, it swells considerably, and will then be almost entirely decomposed. Water no longer dissolves it, and acids produce strong effervescence. By calcination it is brought back to its original state and becomes again completely soluble in water.

It is evident that constant boiling is required to obtain the soluble water-glass in a solid state by means of evaporation, in order to prevent the carbonic acid from penetrating the mass. The same precaution must be observed when fused water-glass has to be dissolved, and care must be taken always to add boiling water in order not to interrupt the ebullition, and thus to allow the access of carbonic acid.

When solid or pulverized water-glass is exposed for some time to the action of the atmosphere, it undergoes the same change as during the evaporation. It effervesces strongly on addition of acids, and is only partly soluble in water, leaving a heavy deposit. On being strongly ignited, this residue becomes again soluble. If a drop is allowed to fall on the table or on the floor, it soon loses its transparency and becomes opaque, owing to a partial decomposition. The same takes place when it is poured from a bottle and a drop runs down outside the vessel; white streaks, which are difficult to efface, make their appearance. If the liquid glass is kept in a bottle which is only half-full and badly stoppered, a white deposit or ring is formed after a short time, which adheres so firmly that it cannot be removed entirely even by acids, and a more or less heavy deposit is found on the bottom of the vessel, owing to a partial decomposition of the water-glass—a fact which I did not become aware of for some time, on account of insufficient experiments and observations. I have stated in the above-mentioned pamphlet, p. 396, "that the dried and pure water-glass undergoes no palpable change by exposure to the atmosphere, and that it attracts from it neither water nor carbonic acid. A concentrated solution is likewise not perceptibly affected by the atmosphere, although it is decomposed and converted into a stiff jelly by passing a carbonic acid through it. A dilute solution becomes turbid on exposure to the air, and is gradually entirely decomposed."

I herewith correct this error.

When concentrated water-glass is brushed upon a solid substance, such as glass, marble, or thick paper, it soon dries up and forms a shining transparent coating, which, however, does not keep long, but becomes gradually dull, opaque, and sometimes fissile and cracked, and of a somewhat pulverulent appearance. This gradual change is caused by water which the air-dried water-glass retains in rather considerable quantity (about 12 per cent.), and which it loses but slowly, whilst it contracts more and more and acquires considerable hardness.

One of the most important properties of the water-glass, and one which renders it most suitable for practical purpases, is its binding and cementing power; it may be employed for imparting solidity and greater cohesion to loose masses, for joining separate parts of bodies or small particles to form a large whole, for filling up cracks or fissures, &c., and many more applications. Its action resembles that of glue; and it might, in fact, be called a mineral glue.

Its effects are most apparent when it is applied upon solid porous bodies which absorb it, and when it is brought together with pulverulent dust or sand-like bodies, or with substances which can be crumpled up between the fingers, but which are converted into a stone-like mass, from which the water-glass can no longer be dissolved.

The intensity of the effect produced depends upon the nature of the substances with which the water-glass is brought into contact; some possess a stronger affinity than others, and consequently are more powerfully cemented than others. There is, however, this essential difference, that a few, such as magnesia and oxide of zinc, form with the water-glass a chemical compound, whilst others are only mechanically combined, owing to mere adhesive action. The former action, by which bodies are rendered hard and insoluble, will be readily understood, because an insoluble double silicate is formed by the combination with a second base. The latter is more difficult to explain, especially since the water glass shows a slightly different deportment with different bodies, and it is therefore not at all immaterial which body is chosen in order to obtain an intimate solid mass which resists the action of the water. Thus, for instance, water-glass exhibits a much greater power of adhesion for powdered marble than for powdered quartz. It has been shown, moreover, that the carbonic acid of the air promotes the consolidation of the water-glass, because it is partially decomposed when exposed to the air; however, this is not sufficient to explain the striking change which frequently becomes perceptible after the lapse of a few days. Carbonic acid, no doubt, loosens the slight tie which exists between silica and the alkali; but then the former does not remain passive, passing, according to its peculiar nature, through various states of cohesion, becoming itself active, retiring, so to speak, entirely upon itself, and cohering so intimately with the particles of the body with which it is brought into contact, and for which it possesses a strong adhesion, that the whole mass becomes

petrified. If, therefore, a body does not readily cement with water-glass, it will only be necessary to add a material which combines chemically with the latter, when the desired end is sure to be obtained.

I call a mixture of pulverulent or sand-like bodies with water-glass which cements well, *water-glass cement.* It may be advantageously employed in various cases instead of the common chalk-cement, as will be shown hereafter.

Water-glass imparts considerable hardness to porous bodies which absorb it, such as vessels of baked clay, plates, bricks, tiles, pottery-ware, &c.; as also to porous limestones, sandstones, and to timber.

It has been stated that water-glass does not cement all solid bodies equally well, and it will be interesting to know which bodies are more or less inclined to combine with it. I will mention only those which are available for practical purposes, and state the experiments which were made to ascertain their deportment.

a.—Carbonate of Lime.

(Chalk, Calcareous Sand, Powdered Marble.)

When chalk-powder is made into a paste with water and then well-dried and saturated with water-glass, it forms a compact mass. According to Buchner, if a piece of chalk is plunged into a moderately concentrated solution of water-glass, and left for about two days in the solution, then taken out, dried, and again put into a somewhat more dilute solution, it is found to be entirely soaked with it, and acquires on drying such an even hardness that it is very little inferior to marble, and capable of a good polish. Water does not soften it, though it assumes a slight alkaline reaction; the chalk is also increased considerably in density. Baron Liebig and Professor Buchner have confirmed this remarkable deportment of water-glass by their own experiments. Chalk, therefore, forms an excellent ingredient in order to render water-glass cohesive and insoluble in water.

The question will be asked, what produces this remarkable change in the otherwise soluble water-glass? Is it in consequence of a chemical process, *i.e.* does an interchange of the elements of carbonate of lime and water-glass take place, so that on the one hand silicate of lime, and on the other carbonate of potash, are produced?

The change of the water-glass is no doubt of such a kind, that Professor Kuhlmann may well be excused for holding the opinion that it is based upon a chemical process. This is not the case, however, as I have already stated in the pamphlet referred to, p. 400: "Several insoluble salts, such as carbonate and phosphate of lime, which do not possess the power of decomposing the water-glass, have so strong an attraction for it, that when it is evaporated with them, it loses its solubility in water, either partially or wholly."

Baron Liebig and Professor Pettenkofer have lately proved beyond all doubt, by numerous carefully conducted experiments, that no chemical interchange of elements takes place, and that not even a partial decomposition of the water-glass is perceptible.

Is then this extraordinary change merely caused by adhesion? I think that the water-glass and carbonate of lime combine directly, *i. e.*, without a mutual decomposition, forming a weak chemical compound such as is met with in the mineral known by the name of "cancrinite," which is composed of nepheline (silicate of soda and alumina) and carbonate of lime. A silicate of analogous composition has been discovered by Professor Schafhäutl in Tyrol, and called by him "didymite."

Cases are known, moreover, of undoubted adhesive action, in little or no way inferior to chemical action. I will only mention iron flint, which to all purposes is a mixture of oxide of iron and quartz; the former adhering, however, so firmly to the latter, that the strongest hydrochloric acid does not dissolve the whole of the iron from a finely powdered ferruginous quartz, even on long continued boiling, as has been shown by the experiments of Bucholz.

Powdered marble exerts the same action upon water-glass as chalk, and forms a very compact mass wich it, especially a very good cement. This cement, which may be prepared of more or less coarsely-powdered marble, may find useful application for many practical purposes, as well as the analogous mass of chalk and water-glass, since it adheres to wood as well as to stone.

b.—Dolomite.

A mineral consisting of carbonate of lime and carbonate of magnesia, which, according to experiments lately made, appears to surpass even limestone in its cementing power; and as it is considerably harder than limestone, a mixture of its powder with water-glass imparts a strong resisting powder against external, mechanical as well as chemical action. It may be classed with the best means of cementing the water-glass and to render it insoluble in water; and since it occurs frequently in nature, it may be obtained without incurring any great expense.

c.—Phosphate of Lime.

(Bone-ash.)

Phosphate of lime also gives a very compact mass with water-glass, scarcely differing in consistency from that with carbonate of lime, and, as far as has been ascertained, without undergoing any chemical action or change of its constituents. Although it is not likely that phosphate of lime will be much employed, it is interesting to know its deportment with water-glass, because it is sometimes formed by the combination of phosphoric acid and lime and brought into contact with water-glass, as will be further illustrated hereafter.

d.—Caustic Lime.

(Slaked Lime.)

Water-glass sets rapidly when caustic lime is mixed with it, and dries slowly to a rather hard mass. A chemical combination takes place between the lime and water-glass, and potash is liberated, if a sufficient quantity of water-glass be present. It is evident that water has no action upon this product. It may serve advantageously as an admixture to other masses which do not cement so well; only little can be added, however, lest the solution sets and prevents the water-glass from penetrating.

e.—Lime acted upon by the Atmosphere.

(Basic Carbonate of Lime.)

May conveniently be added to water-glass by rubbing the two substances together; it does not set rapidly, but dries up gradually to a solid mass, which is a chemical product consisting of silicate of potash and lime. Slaked lime forms a useful addition to other masses, since it will soon be converted into carbonate of lime by the action of the carbonic acid of the air, and walls coated with mortar may, after a short time, be impregnated with water-glass in order to cement them better.

f.—Pulverulent Quartz.

Quartz may be powdered as finely as possible without exhibiting any strong adhesive power or inclination to form a cement with the water-glass. If it be made into a kind of cement, and placed upon a tile moistened with water-glass, it dries up to a solid mass after a few days, and resists rain and becomes as hard as a stone on the surface. But if that surface is pierced and the inner part examined, it is found quite disintegrated and void of water-glass, the whole of which has been drawn to the surface. Repeated soaking in water-glass is necessary to render the mass homogeneous. A compact mass which leaves scarcely anything to wish for, is however obtained when a little dry-slaked lime is mixed with the

powdered quartz, and then the mixture treated with water-glass.

The same takes place when water-glass is added to mortar made with quartz-sand and slaked lime, after the mass has been well dried.

g.—Burned Clay, and burned Porcelain Clay.

These two bodies do not belong to those which bind well with water-glass. We observe the same action as with powdered quartz. The water-glass only combines superficially with them, and leaves underneath a porous powder, which will only bind if repeatedly moistened with water-glass.

There exists a remarkable difference between vessels made of different kinds of clay, which become, as is usual, porous by burning, so that they absorb the water-glass readily. If, for instance, a burned plate of potter's clay which possesses no particular hardness, and can easily be broken to pieces, is saturated with moderately concentrated water-glass, and if the soaking is repeated after it has become dry, it is rendered so hard that it resists both chemical and mechanical action which is made to bear upon it. Thus Professor Kaiser prepared a plate of tile clay about half an inch thick, which was so friable that it would have fallen to pieces under the slightest pressure before being saturated with water-glass, and used it as a covering plate in an evaporating oven; and although vapours of all kinds have been passing over it for the last twelve years, they have not produced the slightest change. It is evident that potter's ware of various kinds can be rendered as durable as a plate of clay, provided they take up the water-glass readily.

h.—Zinc White (Oxide of Zinc) and Magnesia.

These two bodies combine most energetically with the water-glass, and hereby shew the same close analogy which we notice in several others of their natural as well as artificial chemical compounds.

Oxide of zinc may be ground together with water-glass without setting too rapidly. If this mass is spread rather thickly upon a slab moistened with water-glass, it contracts slowly and becomes gradually harder till it breaks up into many small pieces, which detach themselves from the support. When treated with water, these pieces retain their hardness and are no longer disintegrated; they impart a weak alkaline reaction to the water. It is evident that oxide of zinc forms an intimate chemical compound with water-glass.

If the mixture of oxide of zinc and water-glass is brushed in a thin layer upon objects, it adheres firmly to them and gives a good coating, to which a colour may be added, if desired.

This powerful action of the oxide of zinc makes it a very useful article to add to those substances which, by themselves, do not bind readily with water-glass. Even to those that do, a small admixture of the salt can be advantageous, and tends to increase the solidity, or, at all events, prevents the water-glass from making its way to the surface.

Pure magnesia, also called *Magnesia usta*, from the way it is prepared (by igniting pure carbonate of magnesia), when ground together to a paste with concentrated water-glass, sets more rapidly than a mass of oxide of zinc and water-glass, and dries up to a very hard mass, but it is liable to crack and peel off when it is put on a solid body in a layer a little thicker than a card-board. The pieces which peel off exhibit considerable hardness. Water in which they have been boiled has an alkaline reaction, but gives no cloudiness with sal-ammoniac, a proof that only a little potash, but no silica, or merely a trace, is dissolved*.

* It is by no means remarkable that a little potash is dissolved on grinding this or a similar mass with water, since it has been found that common glass is slightly soluble in water when ground for some time in an agate mortar, and that when water is boiled for some time in a glass retort, the glass is acted upon, as was first observed by Scheele.

I have no doubt that magnesia as well as oxide of zinc combine chemically with water-glass, and that the former may conveniently be employed as an additional ingredient to other masses which possess less binding power.

Experiments have been made with *Magnesia alba* as an admixture to water-glass, which have proved perfectly satisfactory. This kind of carbonate of magnesia was made into a paste with concentrated water-glass, and placed upon a glass plate; it soon acquired considerable solidity, and adhered so strongly to the plate that it could only with difficulty be detached by means of a knife. A few pieces were put into water and digested for a short time; it dissolved a little carbonate of potash but no silica, which would have been indicated on the addition of sal-ammoniac. The consistency of the mass was not perceptibly altered. A part of it was powdered and boiled with water, when again traces of carbonate of potash only were found to be dissolved. Another portion was treated with dilute sulphuric acid, which gradually produced a slight effervescence, dissolving magnesia and the rest of the potash, and leaving behind silica as a gritty powder, which was perfectly and easily soluble in caustic potash.

Magnesia alba and water-glass undergo, therefore, a chemical action, by forming a little carbonate of potash, whilst silica, with a part of the potash, combines with the magnesia. Magnesia alba forms, therefore, one of the most important cementing ingredients which can be added to water-glass.

Gypsum.

Hydrated Sulphate of Lime (CaO, SO^3+2HO).

When gypsum is ground together with water-glass it solidifies immediately, and on drying, much sulphate of potash or sulphate of soda separates, according as potash water-glass or soda water-glass has been employed in the experiment. The mass is, however, scarcely more solid than the ordinary gypsum. No doubt, a chemical action has taken place. It follows that objects made of gypsum cannot be impregnated with water-glass in order to render them more solid and capable of resisting the action of the atmosphere, because it does not penetrate into the pores. Gypsum must therefore be avoided in selecting admixtures for the water-glass; moreover, care must be taken to avoid such bodies as might form gypsum in the operation, or as might already contain gypsum.

Anhydrite, or anhydrous sulphate of lime, and, I think, strongly ignited gypsum, promise a better result; but I am unable to speak definitively on this point, as the experiments have not yet been brought to a conclusion; and I hope to be able to publish some interesting results with regard to the action of that and other substances upon water glass, viz., heavy spar, fluor-spar, oxide of iron, basic salts of iron, litharge, lead-white, &c.

The state of concentration of the water-glass is a matter of considerable importance in these experiments, and still more so in its practical application.

One part by measure of concentrated water-glass to two parts of water, may form the maximum, and one part of the same water-glass to half a part of water, sometimes even less, according to circumstances, the minimum of dilution. If it is too concentrated, it does not penetrate those bodies easily and sufficiently which it is desired to impregnate; if it is too diluted and made into a paste with pulverulent bodies, this mass may appear coherent enough when first dried, but will be found more or less friable and loose after a few days, and repeated impregnation with water-glass only can impart to it the desired solidity. Dilute water-glass interposes too much between the particles of a body, so that numerous small interstices are left, which weaken the cohesive power when the water-glass contracts on drying. All depends upon how far the saturation of such bodies with water-glass is to be carried on,—whether they are to be com-

pletely saturated with it, or only to a certain degree. In the first case we attain the greatest possible solidity; in the second we gain the advantage that colours or a coating of paint can be put on at any time and fixed by means of water-glass. It must be left to the operator to modify at will the state of concentration, and to adapt it to his purpose. I will merely state, that a body which has been completely saturated with water-glass can be again rendered porous by warming it, or, what is easier, by burning alcohol once or twice on it.

The pores open a little more in the course of time, especially on exposure to rain, which dissolves part of the alkali and leaves principally silica, so that at last complete petrifaction takes place, and the desired object is attained.

The question will be asked, which of the several kinds of water-glass answers best, and is the most suitable for practical purposes. Nothing definite can be stated as yet. It is possible that the potash water-glass, which sets more rapidly than soda water-glass with powdered substances with which it is mixed, may impart greater solidity to them than soda water-glass; the difference, however, cannot be considerable. On the other hand, the soda water-glass has the advantage of being more liquid, and penetrating more readily into the smallest spaces, pores and fissures, than the slightly gelatinous and difficultly soluble potash water-glass, a property which is of some importance to the sculptor and mason.* Soda does not combine so strongly with silica as potash, and has a strong inclination to efflorescence when combined with the carbonic acid of the air; and one of the advantages of soda water-glass might be due, therefore, to its parting readily with the silica, and thus accelerating the silicatisation of the mass. Further experiments, however, are required to prove its superiority.

The double water-glass seems to unite the properties of the other two, and merits preference, for the very reason that it contains two bases (potash and soda) with which silica (which prefers to form double compounds) combines more powerfully.

The fixing water-glass is used for the particular purpose already stated, but it can also be employed in many other cases, especially in painting.

The first three kinds of water-glass, when completely saturated with silica, are always more or less cloudy or opaque, owing to undissolved and very finely divided silica.

In order to deprive them of this opacity, it is sufficient to add a little liquor silicum, and to allow them to stand for about a day, stirring them occasionally. The opacity disappears completely, and the liquid becomes perfectly clear, provided it be not accidentally coloured by some other (organic) substance.

I have further to remark, that after some time a dust-like efflorescence, sometimes of slightly crystalline appearance, takes place upon bodies which have been impregnated with water-glass. This efflorescence has frightened many, and caused the water-glass to be looked upon with suspicion. But this efflorescence is far from being obnoxious; it proves rather that the process of hardening proceeds favourably, by which a little alkali is expelled, thus enabling the silica, which no doubt forms the principal binding element, to act more freely upon the bodies to which the water-glass is applied.

If the efflorescence is removed by means of a wet sponge, it will be found that the solidity of the body thus treated is not only not impaired, but even increased.

* The late sculptor Professor Maier told me, that he was enabled to employ a faulty stone in a few days as if it had contained no fissure, by dropping a few drops of soda water-glass into the crevices. He could not employ potash water-glass equally well, since it was not so liquid, and did not penetrate into the fissures.

I thought at first that this efflorescence* consisted of bi-carbonate of potash, because it was derived from potash water-glass, but more careful examination by M. Feichtinger, assistant in the chemical laboratory of Professor Pettenkofer, proved it to be carbonate of soda mixed with scarcely a trace of potash. All commercial potash derived from the ashes of plants—and such was the potash employed in the manufacture of this water-glass—contains more or less carbonate of soda, and thus the occurrence of carbonate of soda can be easily accounted for.

(*To be continued.*)

HOUSES IN RELATION TO HEALTH.

The following is an abstract of a lecture delivered at the Royal Institution on Friday, May 6, by Mr. R. Druitt:—

The speaker having alluded to the sickness, bereavement, and ruinous expense which sometimes ensue from the wrong choice of houses by private individuals, and to the disorders liable to be diffused amongst all classes, from the unhealthy dwellings of the poor, proceeded to consider the subject of houses and their influence on health, under three heads. Under the first, he treated of deficiencies of air, light, warmth, and dryness, and of the maladies of degeneration to which they give rise, of which consumption and scrofula are types; under the second, he spoke of the common typhoid fever of this country, and of choleraic disorders, and of their origin in defective house drainage; and under the third, he discussed the conditions which give intensity and power of propagation to certain diseases, such as scarlatina and diphtherite.

Amongst the details noticed under the first head, he observed that the ground on which a house is built should have the qualities of porosity and firmness; porosity is required in order that all water charged with organic debris, which happens to penetrate it, may pass onwards and undergo that rapid oxydation which is so happily effected by the London gravel. Wherever the soil is deficient in this quality, or where beds of gravel or sand come in contact with beds of clay, a thorough subsoil drainage is as essential for the health of man as it is for the growth of sweet herbage. Spots can be pointed out in which the subsoil is swampy, and where fever has prevailed in consequence. Moreover, the land on which houses are built around London is sometimes raised artificially by what is called made-earth; that is to say, on a low, wet spot, quite undrained, are heaped all sorts of rubbish, road scrapings, mud, and refuse, mixed with organic debris; and over this the houses are built. Besides, the excavation of sweet wholesome gravel, and the filling in the vacuity with rubbish, has long been prevalent at the west of London, and was much to be condemned; and an instance was quoted of a house, whose rental was £400 per annum, built over a laystall of the last century, that is, a pit where every kind of impurity was deposited, and now filled with black mould mixed with sheep bones. This earth, when dried and

* This efflorescence is by no means identical with that which frequently occurs on damp walls, and which acts so destructively by loosening the plastering or cement, or by detaching it all together, and which is most appropriately called "Mauerfrass." The latter is caused by salts which are contained in the material employed for building walls, most frequently by saline bodies found in the spring water which is used in preparing it. Not unfrequently saltpetre is formed simultaneously. This evil abates only when all the salts present in the mortar have effloresced. Another source of the decay of walls is to be found in the damp or saline soil upon which the walls are built, and from which the wall absorbs the salts unceasingly. A fresh coating of cement, after carefully removing the old, will improve the appearance of the wall, but only in order to furnish fresh material for slow destruction. A coating of water-glass cement, put on after carefully cleaning and impregnating the damaged wall with concentrated water-glass, can alone efficiently stop the destruction for a longer period of time.

analyzed, yielded 10 per cent. of organic matter, and was as unwholesome to build on as an old churchyard.

Want of firmness might be remedied by a solid floor of concrete, after the Roman manner, which would enable houses to be built with less chance of settlements and cracks, which are causes of unhealthiness, not merely by allowing cold and damp to enter, but by permitting currents of fœtid air to come from unknown and distant sources. Thin walls, too, render a house not only extremely cold, but unwarmable in winter.

Passing over the grouping and position of houses, and the width of streets, which ought to be regulated by the height of the sun in winter, we come to the internal arrangements and air supply. The last may be provided by some special ventilating apparatus; or may be left to take care of itself; but even if left to itself, it will be prudent to see that the basement doors, and other chief apertures, are not near any source of contamination; moreover, great caution should be exercised in roofing in yards and areas with glass, as is often done, because the glass may cover over some sources of effluvia, and bring them into the house. This has been the cause of fever.

The supply of air to the apartments should be large, diffused, and not in perceptible draughts, and warmed, and should be so contrived as not to attract attention: otherwise persons who are afraid of pure air, especially servants and the poor, will speedily close up the apertures. The plan suggested by the Commissioners on Warming and Ventilation was exhibited, and described as fulfilling most of these conditions—inasmuch as the air is warmed by the heat otherwise wasted by the chimney, and is introduced in ascending currents; and care is taken that there is a channel of escape separate from the chimney, and that the upper part of the apartments should be the coolest. Any plan for bringing currents of cold air to the level of the feet, or of the bed, is to be condemned. Nothing can be a better evidence of the carelessness of our present system of air supply to houses, than the fact that much of it comes down the chimneys when there is no fire, bringing with it abundance of soot, and many, possibly unwholesome, products of imperfect combustion of organic matter.

A free supply of pure air is the *sine qua non* to persons who lead in-door lives; inasmuch as the direct influence of close bedroom air in producing scrofula and consumption had been proved incontestibly by Carmichael of Dublin; and later, by Dr. Guy. But till people have a sufficiency of food and clothing, it is a mockery to speak of pure air. Man's instinct chooses foulness before hunger, when the contact of pure air with the lungs, and of pure water with the skin, creates an appetite for food which he has no means of satisfying.

Further researches on the composition of house air are to be desired. It is evident that the amount of carbonic acid represents that of the most volatile, and probably that of the most innoxious product of the presence of living beings, and consequently the *minimum* of atmospheric impurity. The speaker had made several determinations which showed how rapidly the quantity fluctuated according to the amount of ventilation and the state of the wind. For example, in a small room in May's Buildings, Brick-street, inhabitated by two adults and three children:—

	Volumes of Carbonic Acid in 10,000 vols. of air.
April 20th. Noon; family dining	13·74
„ 21st. „ „ „	9·19
„ 24th. Room empty, door open ...	3·34
„ 20th. All night	15·97
„ 21st. „	15·10
„ 22nd. „	12·27
In the Infant school-room, Curzon schools, Mayfair, room crowded, with a window open at each end	9·46

In a bedroom, unoccupied, but with the doors and windows closed all day, the quantity fluctuated between 5 and 7 volumes per 10,000.

The list of maladies arising from cold, damp, airless and sunless dwellings, is a long one, and is identical with the maladies caused by hunger, depraved nutrition, solitude, and grief; moreover, the effects of dark, monotonous, and decayed dwellings upon the mind must not be overlooked, inasmuch as they produce a direct temptation to indulge in spirituous liquors.

Under the second head, the speaker alluded to the great number of modes in which a house may receive poisonous vapours from sewers. If the house drainage has not been revised during the last ten years, there may probably be every variety of imperfect and dilapidated drainage; wells that once supplied a family with water, may have beeen converted into dead wells and receptacles of filth; and even when a house possesses a perfect drainage system of its own, it may be invaded by its neighbours; or the remains of old drainage systems may have been left by the carelessness or ignorance of workmen. Every pipe, too, of whatever sort, may be a means of bringing foul air from sewers; every such apparatus should, therefore, be examined from time to time, and be regulated with philosophical precision. The possibilities were described of the entrance of air from the public sewers into houses; either from stagnation and decomposition, or through the wind which at certain times penetrates the great sewers from the river; then, wherever a sewer ends abruptly, the gases are sure to be driven out of it, through the apertures in the streets made for ventilating purposes.

The effects of back house drainage, and of sewer poison, are found in the prevalence of typhoid fever and choleraic maladies.

The great fevers at Clapham, Croydon, Westminster, and Windsor, were all of this sort, and traceable to this cause; and instances were given of illness, year after year, visiting a family, and robbing it of one or more lives; and when too late, the discovery made that an ancient, unknown, and decayed sewer ran under the premises. Many such sewers exist underground, not noticed in any map, and unknown to the present generation of officials; serving only as reservoirs of foul gases, which find vent through most unexpected channels.

It is in vain for the physician to discuss remedies whilst the patient is still breathing the vapours which caused the disease.

Lastly, the property which the diseases have of lurking in certain quarters, and then breaking out with virulence, and acquiring a self-propagating force, was ascribed to impurity in general, and to defective drainage in particular. Scarlet fever, especially, was asserted by the speaker to be caused *ab initio*, as well as to receive power of extension from this source; but the limits of the hour did not permit him to develop the evidence on this point. Thirteen contagious maladies, at the least, can be produced at will; and the speaker believed that, in time, epidemic diseases would be found subject to human control; and that the surest mode of protecting the dwellings of the rich was to cleanse and ventilate the dwellings of the poor.

Diagrams were exhibited, showing the mortality in several parts of the parish of St. George, Hanover-square, by which it appeared that, out of 20,000 inhabitants of first and second class streets there died *at home*, in the three years 1856, 1857, and 1858, 10·78 per thousand per annum; whilst, in third and fourth class streets, there died *at home*, in those three years, 20 per thousand per annum, exclusive of deaths in hospitals and workhouses. Taking the *mews* separately, there died *at home* 15 36 per thousand per annum.

The mortality and population of several streets during these years were also exhibited in a diagram, which contrasted the low mortali y of purely aristocratic and first-class business streets, with that of the nest of low streets between Grosvenor-square and Oxford-street, where, owing to the crowded and unventilatable state of the

houses, there is a mortality of 30 per thousand, a mortality enhanced, of course, by the deaths of the children who are born but cannot be reared in such habitations.

Home Correspondence.

EXAMINATIONS.

Sir,—Allow me to congratulate the Council of the Society of Arts on the successful termination of the Society's Examinations for the present year. The cause of "popular education" is stimulated by the peaceful rivalry which has been organised by your Society, and the competitors, whether successful or not, will have been benefited by the studies they have undergone.

I believe that the manner of conducting the Examinations is above suspicion, and that all the competitors will concur in this opinion. In considering the list of prizes however, it appears to me that the candidates do not compete on equal terms. For example, three members of the Bristol Athenæum obtained six first-class prizes and one second. I do not find fault with their success, but it seems none of them have a trade, either present or proposed, which leads me to imagine that their education has not been obtained in the Institution which they represent.

Now, the great proportion of students in our Mechanics' Institutions, Working Men's Colleges, and similar places have been at work for years before the ages of the successful members before mentioned. In fact, to give my own experience (I am only one of a class), I had been almost eight years at work before I had attained the age of Mr. Hale, and the only instruction that I previously received was a little reading, writing, and arithmetic. Amongst the candidates generally, however, may be found various staple trades, and the success of our artizans and mechanics will better test the value of the "Institutions in Union," than the victories of some other societies composed of a different class of persons. To give a few examples from the list of certificates awarded, would better show the value of the Society's Examinations than a page of written matter.

No. 132—An Edge-tool striker.—Certificate 2nd class; Latin and Roman History.
,, 377—Cordwainer.—Certificate 2nd class; Chemistry.
,, 300—Engineer.—Certificates for Arithmetic, Algebra, Statics, and Chemistry.
,, 478—Cabinet Maker.—Certificates for Electricity, Magnetism, and Chemistry.
,, 111—Plane-maker.—Certificates for French and German.
,, 128—Cutler.—Certificates for Algebra, Geometry, and Mensuration.
,, 347—Wool-sorter.—Certificates for Geography and English History.

These examples show the importance of our Institutions for adult education; and the Society's Examinations enable the various societies to measure their attainments by one common standard, which will command respect.

I hope none of the unsuccessful competitors will be discouraged; but I feel persuaded that mechanics or artizans cannot, as a rule, successfully compete with persons who have received much higher intellectual training, as well as for a much longer period.

Personally I am quite satisfied with my own success; but, hearing the subject discussed, I thought the attention of the Council ought to be called to this subject, and if the insertion of this in the Society's *Journal* should help on the cause of intellectual improvement, no one will rejoice more than

A COMPETITOR.

Sheffield, June 14, 1859.

UNIFORM MUSICAL PITCH.

Sir,—I was present at the meeting held at the Society of Arts on Friday, the 3rd inst., and listened attentively to all that was said with reference to the musical diapason. The question seems to me to be left thus, either to adopt at once a pitch because the French have made it a standard, or to take some other tone as a compromise. For many years past I have paid attention to the subject, and, to me, it seems obvious that the human voice is the natural basis upon which the matter should be determined. The only difficulty is in the application. But the following suggestion will, I think, remove the difficulty, and settle the diapason on a rational basis.

The extent of the human voice is four octaves; from the E of the first ledger line below of the base clef, to the E on the third ledger line above of the treble clef. But the D below has been reached, and also the F above. These are the extremes, making some allowance for variation of pitch beyond which the human voice cannot go. Now, the D below has been written for by Handel, the F above by Mozart. As the pitches of both these periods are known, we have these two starting points. The F above has also been sung at the Philharmonic, the pitch of which varies from the other two; and we thus have a third point, all three based upon the powers of the human voice. Now, I propose that a mean be taken of these three pitches, and whatever the number should be, that that number should be taken as the musical pitch, founded on the limit of the human voice. A selection not arbitrary, as is the case with the French pitch, or, as I conceive, the case must be if the pitch is taken in any other manner. The great advantage of this plan would be that there is a reason for it, which cannot be said of the French pitch. I do not consider that the mere fact of the French having made a selection should have any weight, for any pitch could be enforced in France, which certainly could not be done in this country; it is therefore essential that we should have a natural and rational basis, and such can alone be taken upon the human voice.

I must confess I do not understand what is meant by brilliancy as depending upon pitch. A note or a succession of notes is not of itself brilliant, the brilliancy lies wholly in the performance, not in the pitch, and the want of effect complained of, which has caused the gradual rise of modern days, is chiefly owing to a want of continuity of tone. Singers and players for the most part do not blend the tones fully in passing from one note to another, whatever may be the interval, and thus to the ear there is always a sensation as of falling in pitch, arising from a sensible break in the continuity of tone. Remove the cause, by blending the tones more fully together in the performance, and it would be at once felt that the pitch has nothing whatever to do with brilliancy of effect. Again, purity of tone is an important element as affecting the note itself and consequently the sensation of pitch. Let the note deviate in the smallest degree from purity in the intonation, and the sensation is that of flattening the pitch. Now purity of tone in the performance generally is the exception, not the rule, hence the craving of the ear for a higher pitch to act as a counter-irritant. If this view is correct, of which I have no doubt myself, and it may be easily tested, it does away with all the gratuitous suppositions advanced in the French report, and which, to say the least, are beneath notice. Apologising for obtruding myself at such length,

I am, &c.,
W. W. CAZALET.

6, Grosvenor-street, Grosvenor-square.

Sir,—Conceiving that the remarks of professional or scientific men ought to have more weight than those of amateurs, I forbore, on Friday, the 3rd inst., from taking up time which others might occupy more profitably. Now, however, I venture to offer three suggestions on

the subject, which seem to me to have been overlooked in the discussion.

First, As to the strain on the voice of the modern pitch—certain songs in Mozart's "Flauto Magico," written for his sister-in-law, Aloysia Weber, were referred to in the debate aforesaid as inaccessible in the present day—being about the highest songs ever written. Now, without pleading that they were written for an exceptional voice,—accompanied by a feeble orchestra—a voice called on, however, to warble merely, and not to speak in *altissimo;*—it may be stated that they have been sung by no less than five ladies lately before the public—Mesdames Lind Goldschmidt, Gassier, Zerr, La Grange, Miolan Carvalho, while the deep bass songs in Mozart's "Serraglio" can be touched by no modern *basso.*—Can it be that certain qualities of voice die out or reappear at certain periods, in this holding analogy to physical peculiarities exhibited in health and disease, or to the extinction of certain varieties of plants and fruits?—If not, the fact, susceptible of proof by anyone familiar with musical performances, suggests the possibility that the alteration of pitch complained of has been exaggerated, and the testimony is open to cross-examination.

Secondly. It is observable that "the interest of composers," cited in paragraph 4 of the French report, signed by M. Halévy, M. Meyerbeer, Signor Rossini,—a French, a German, and an Italian composer—as a reason for lowering the pitch, has been commented on singularly by these gentlemen themselves, who, free to write in any key they pleased, have habitually written one-third higher for each voice of the quartett than the composers of the last century. The tenor part in "Guillaume Tell" rises a tone higher, and on words to be spoken (not notes warbled), than the counter tenor part in the "Messiah." (See the Swiss introduction, the Terzett, in the second act, and the final song, made memorable by the chest C of M. Duprez.) In "Le Prophète," M. Meyerbeer calls on his soprano to dwell and declaim (not to warble) on B natural and C sharp in alt. The highest note I remember in a score by Handel, is B flat in alt, in "Thais led the way" (Alexander's Feast), memorable as a rarity:—and the note is there touched, not expatiated on.

Thirdly. I submit to those requiring one pitch for all Europe, that it would be unwise to attempt this unless all European voices had one and the same quality and register. So far from this, the general scale of German tenors is higher than ours. France and Germany have no contralti; Italy and England have. Germany has no baritones; and, I believe, every musician will bear me out in asserting that the same vocal quartett, executed by four groups of voices from the four countries, in precisely the same diapason, would suggest to a nice ear a sensible difference of tune, owing to the difference of timbre. For these reasons, not to speak of the impossibility of carrying out any restrictive measures, the effect of which has yet to be tried in France, I respectfully protest against any such formal adjustment as necessary, or as conducive to a uniform excellence of musical performance, even should it be proved possible.

Yours, &c.,

HENRY F. CHORLEY.

Sir,—The French Commissioners who have presented their very able report, seem to have overlooked a primary cause of the successive elevation of the pitch, diapason, or general orchestral tone now in fashion, which is partially due to the successive improvements of wire-drawing manufactories, both in material and workmanship.

It is a well-known axiom in stringed instruments that the finest musical tone is produced when the wire or catgut is so strained as to be on the point of breaking, therefore the greater tensile strength, with a given diameter and length, any material may possess, the more powerful and musical will be the result. Compare our modern steel wire with that of a harpsichord a century old, and it will be found that it is not only far stronger size for size, but of much larger dimensions for the same note, and so far from using thinner wire than formerly, our pianoforte-makers are almost daily increasing the size, with great advantage in sonority and power. But they have also, with the same view, elevated the pitch at the same time, which has been a great mistake, because the human voice cannot be mechanically screwed up in the same manner.

Modern pianoforte wire possesses immense tensile strength in proportion to its diameter, and will probably be still more improved, but the brass strings are very weak, and often produce great inequality of tone even in our best instruments. The new alloy of aluminium and copper promises to remedy that defect, and if successful, will almost effect a revolution in stringed instruments.

In regard to instruments strung with catgut, I would suggest that experiments be made with the tail sinews of the great sperm whale of the South Seas, which I believe to be nearly three times stronger, size for size, than catgut, and being without twist, solid, and transparent, would not be liable to break on the approach of bad weather.

They may be obtained from the size of a hair to four inches in diameter, and from fifteen to twenty feet in length. Our fiddler, who had been dumb for some time, strung up and played away within twelve hours of our taking the first whale.—I am, &c.,

HENRY W. REVELEY.

Poole, June 5th.

RELATIVE VALUES OF COAL AND COKE FOR LOCOMOTIVE ENGINES.

Sir,—Would you allow me to inquire who and what is your correspondent writing upon the above subject and signing himself "I," in the last number of your *Journal*?

I think it due not only to myself, but also to the scientific public in general to ask for the information. Both should know what pretention the writer may have to discuss the matter at all. If your Society were composed entirely of gentlemen of my own profession, which unfortunately for me in this instance it is not, I would perhaps let the matter drop without even making the inquiry, as any one who has made or knows how to make a chemical analysis properly of coal and coke can see that the writer "I" is perfectly ignorant of the subject, or he would not have written such absurdities as he has, and which, if I am furnished with the information I require, I may perhaps take the trouble of pointing out.

In conclusion, I would state that I am not singular when I say that allowing the publication in your *Journal* of anonymous reviews or comments upon scientific statements given openly and by men supposed to know something of what they write, indeed whose bread has depended and does now depend upon that knowledge, is, independently of being unfair towards those men, highly derogatory to a journal such as that of the Society of Arts.

I am, &c.,

DUGALD CAMPBELL,

Analytical Chemist to the Brompton Hospital.

7, Quality-court, Chancery-lane, W.C.,
London, June 8, 1859.

Sir,—The reading of Mr. Dugald Campbell's very judicious remarks on some apparently anomalous results in the tables accompanying Mr. Fothergill's paper, makes me regret that some of my observations made on its discussion have totally escaped the reporter, the effect of which is rather to confirm the error attributed to me by Mr. Bethell, that I agreed with Mr. Pellatt and others, that the coke produced from a ton of coal would give as much heat as the original coal, whilst I admitted that hitherto, in commercial operations, such appeared to be

the result, yet, when considered chemically, it ought not to be the case, my illustration being the self-evident fact that, were we to utilise the 9,000 or 10,000 cubic feet of gas and the ten gallons of tar, as well as the residual coke, it left no question but that the coal ought to yield us more "heat-giving properties" than merely those from the coke. I now repeat my expression, that I congratulated the locomotive engineer that there was so much hope in his "smoke-box," and that the French were busily employed to get it out.

Like Mr. Beattie, they are admitting atmospheric air over the fire as well as through the fire, in order to consume not only the mechanical carbon-smoke, but the carbonic oxyde, produced in abundance from all deep fires working at high intensities, especially where aqueous vapour is introduced either in the ash-pit or by damping the coke in the "tender," a practice of very questionable advantage.

We must all thank Mr. Campbell for giving us the fact as well as the authorities for such a statement, that hydrogen ought to give us 4½ times as much heat as the same weight of carbon. This brings to my recollection "Brande's Bakerian Lecture," read in 1818, and the remarks I ventured to make upon it, in the April number of the *Philosophical Magazine* of that year, where I stated as my belief that the heat produced from "oil and coal gas" was in the exact ratio of the oxygen consumed, which statement I have oft repeated at our Civil Engineers Society. I remain, &c.,

GEO. LOWE.

Finsbury Circus, May 28, 1859.

MEETINGS FOR THE ENSUING WEEK.

TUES. ......Statistical, 8. M. de Koulomzine. 1. "On the Duration of Life among Literary Men." 2. "On the Universities of Russia."
WED. ......Royal Soc. Literature, 4½.
THURS .....Philosophical Club, 5½.
Numismatic, 7. Anniversary.
Philological, 8.
FRI. ......Royal Society Club, 6. Anniversary.
SAT..........Royal Botanic, 3¾.

PATENT LAW AMENDMENT ACT.

APPLICATION FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, June 3rd*, 1859.]

Dated 21st May, 1859.

1257. W. H. Perkin, King David Fort, St. George-in-the-East, Middlesex, and M. Gray, Bonhill, Dumbartonshire—Imp. in mordanting and dyeing fabrics of cotton and other vegetable fibres.

Dated 23rd May, 1859.

1261. J. Knowles, Lower Broughton, near Manchester—Certain imp. in power looms or weaving.
1263. W. Crum, Thornliebank, Renfrew—Imp. in printing and dyeing textile fibres and fabrics.
1265. J. H. Mason and G. L. Baxter, Nottingham—Ornamenting lace or other twisted fabrics.
1267. J. L. Julion, Stoneywood Works, Aberdeen, N.B.—Imp. in dressing and finishing textile fabrics.
1269. R. A. Brooman, 166, Fleet-street—Imp. in axles and in fitting wheels thereto (A com.)
1271. W. Clark, Greenock—Imp in machinery or apparatus for propelling and manœuvring ships vessels, and boats.
1273. A. Barlay, Kilmarnock, Ayr, N.B.—Imp. in steam hammers.
1275. A. V. Newton, 66, Chancery-lane—An improved construction of washing machine. (A com.)

Dated 24th May, 1859.

1277. G. Davies, 1, Serle-street, Lincoln's-inn—Atmospheric apparatus for the submarine transport of blocks of stone, and for raising sunken vessels. (A com.)
1279. G. D. Jones, Clerkenwell—Imp. in machinery for grinding, reducing, and pulverising.
1281. W. T. Denham, Wilmington-square—Imp. in the manufacture of goffering machines.
1283. E. Page, Bedford—Imp. in horse drags or rakes.
1285. B. F. Greenough, Boston, Suffolk, Massachusetts, U.S.—An electrical conductor for submarine telegraphs, which he denominates a hpdro-electric conductor.

Dated 24th May, 1859.

1287. J. Harmer, St. James-street, Lower-road, Islington—Imp. in parts of dry gas meters. (Partly a com.)
1289. R. A. Glass, 115 Leadenhall-street—Imp. in submarine electric telegraph cables.
1291. A. Prince, 4, Trafalgar-square, Charing-cross—Im. in the construction of ships and vessels. (A com.)
1293. A. J. Davies, 29, George-street, Hanover-square—Imp. in apparatus for protecting persons when employed in cleaning windows, painting, or working at the exterior of houses and ships' sides, and such like operations, applicable also for purposes of military and other observation.
1295. A. V. Newton, 66, Chancery-lane—Improved machinery applicable to the manufacture of rivets, bullets, and other like articles. (A com.)
1297. C. E. Amos, the Grove, Southwark—Improved apparatus for raising vessels for repair, and for floating vessels in shallow water.

[*From Gazette, June 10th*, 1859.]

Dated 18th May, 1859.

1234. J. Brennand, Manchester—Certain imps. in the construction of carriages for the conveyance of passengers, goods, and minerals, and also in the apparatus for propelling the same.

Dated 21st May, 1859.

1258. T. S. Cressey, Burton-upon-Trent—Imps. in machinery for cutting staves for casks.

WEEKLY LIST OF PATENTS SEALED.

[*From Gazette, June 10th*, 1859.]

June 10th.

2836. A. Barclay.
2837. C. Hodgson.
2849. A. Rollason.
2850. J. A. Carruthers and T. Blackburn.
2851. R. Whittam.
2854. J. E. Boyd.
2855. R. A. Brooman.
2864. R. A. Brooman.
2866. F. Jossa.
2867. J. Pendlebury.
2876. J. Wardill.
2880. R. Wilson, sen., and R. Wilson, jun.
2882. A. Stokes and F. J. Stokes.
2886. J. W. Friend.
2929. F. Ransome.
2937. A. Barclay.
2946. J. Railton and S. Lang.
2956. J. Smethurst.
3003. J. Lees and W. Heap.
55. G. K. Geyelin.
242. J. Kerr.
434. W. H. Horstmann.
651. G. B. Galloway.
761. G. Haseltine.
858. F. M. Crichton.
916. P. Hill.
919. J. Crossdale.

[*From Gazette, June 14th*, 1859.]

June 14th.

2874. C. F. Vasserot.
2884. J. H. Selwyn.
2885. J. W. Edge.
2888. J. J. Marçais.
2890. R. A. Brooman.
2893. W. B. Johnson.
2975. W. Taylor and W. D. Grimshaw.
3001. M. D. Wyatt.
101. R. Mushet.
121. T. Sampson.
133. W. Betts.
141. W. E. Newton.
961. J. Sidebottom.
997. L. P. Porter.
1017. J. Gillies.
1023. W. Gibson.
1047. W. Marshall.
1111. L. R. Blake.

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

[*From Gazette, June 10th*, 1859.]

June 6th.

1358. W. E. Wiley.

June 7th.

1375. R. A. Brooman.
1381. A. V. Newton.
1387. J. Combe.

[*From Gazette, June 14th*, 1859.]

June 9th.

1373. T. Skaife.
1390. J. Eives.
1425. H. Holland.
1427. A. G. Baylis.

June 10th.

1398. A. V. Newton.
1399. W. Massey.

June 11th.

1392 P. Unwin and J. Unwin.
1400. C. J. Dumėry.

LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

No. in the Register.	Date of Registration.	Title.	Proprietors' Name.	Address.
4177	May 27.	Boilers for Heating Hothouses and other uses	Garton and Jarvis	Exeter.
4178	„ 30.	Improved Measuring Tap, for Drawing Off Stated Quantities with each motion of the handle	Charles Dutton and Joseph Jennens	West Bromwich.
4179	June 7.	Apparatus adapted to be used at Windows and such like places to facilitate cleaning, painting, and such likepurposes	William Taylor	Horsley Wylam, Newcastle-on-Tyne.